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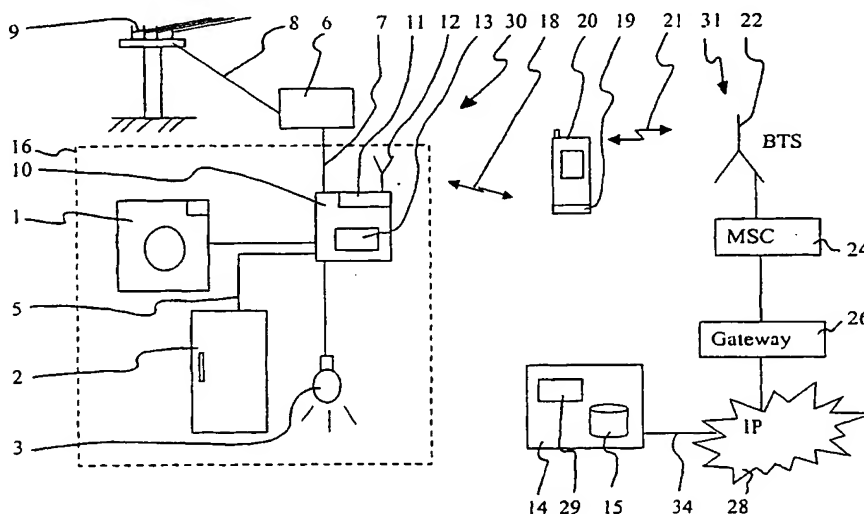
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(54) Title: TRANSMISSION OF CONTROL INFORMATION



(57) **Abstract:** The present invention relates to communication between a device (10) and a remote data processing unit (14). The remote unit may associate with a utility commodity system (9). The remote unit (14) is provided with a connection (26) to a telecommunications system (31). The telecommunications system is adapted to serve a plurality of mobile stations (20). The mobile stations are enabled to communicate with the device (10). In accordance with the disclosed method it is detected that a mobile station is located such that a wireless link may be established between the device and said mobile station. Upon detection of the possibility for communication, information is transmitted between the device (10) and the remote unit (14) via a first wireless link (18) and a second wireless link (21) between the mobile station and the telecommunications system (31). The mobile station is adapted to act as a gateway between the first and second wireless links.

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## Transmission of control information

### Field of the Invention

5 The present invention relates to transmission of control information. A more specific aspect relates to a utility commodity system, and in particular, but not exclusively, to transmission of information to and/or from a controller of a utility commodity system.

10

### Background of the Invention

Different utility commodity systems are known. Typically a utility commodity supply system is arranged to supply a consumer with a flowing commodity such as electricity, gas, water or district heat. The consumer may be any entity consuming the utility commodity, such as a household, an office or an industrial premise. In addition to receiving a flowing commodity, the consumers may be connected to a sewage system. It is to be understood that in the context of sewage the "consumption" means consumption of the resources of the sewage system.

The consumption of the utility commodity needs to be monitored, for example for the purposes of charging the consumer and managing the resources of the utility commodity system. The consumption of the utility commodity is typically monitored by specific meters that are fixedly mounted at the location where the utility commodity is consumed.

30

Typically each consumer has a meter for each utility commodity. That is, each customer or other entity consuming the utility may be provided with one utility meter or several

utility meters. These may operate independently from each other. The consumption of the utility commodity and thus charging of the consumers has typically been based on manual reading of the meters. The meters have been read, for example, once per month, once per quarter of a year or once per year, depending the circumstances and the utility. The manual reading of the meters means in practice that someone has to visit the location and read the meter.

Remote reading of utility commodity meters via a telecommunication system has been suggested. In the remote reading the consumption information will be transmitted between the meter and a remote data gatherer by means of a communication media and an interface apparatus. The data gatherer may be a billing database or similar remote unit for centrally collecting and/or processing the received metering information.

A possibility that has been suggested is to use the public switched telephone network (PSTN), i.e. the public fixed land line network, for the remote reading. The remote reading arrangements that are based on public fixed line connections require dedicated interface devices, such as dedicated data processors and modems, and wiring in order to connect the meter to the telephone line. Should the meter and/or positioning thereof change, substantial changes may be required in the interface and the wiring. In addition, a fixed telephone line is required for the remote reading. The inflexibility and the overall costs of the fixed telephone line based remote reading arrangements are thus among the reasons why they may not be economically competitive when compared to the manual reading of the meters. This may

especially be the case with smaller consumer entities, such as households or small offices or industrial premises.

The communication media between a meter and a data gatherer  
5 may also be provided via a wireless connection. The wireless remote reading may be based on use of a dedicated radio link between the meter and an access point to a public telephone network. Alternatively, a dedicated radio link may be provided directly between the meter and the data gatherer. A further  
10 possibility is to connect the meter directly to a public land mobile network (PLMN), wherein the PLMN provides the radio connection link between the meter and the data gatherer. In the latter arrangement the meter has to be provided with a dedicated interface arrangement for enabling the meter to  
15 access the PLMN.

The arrangements employing at least one wireless connection for the remote reading provide a greater flexibility and remove at least some of the wiring required by the fixed line  
20 solutions. However, the radio based solutions previously suggested still have some disadvantages. For example, if a low power radio link is used for the transmission between the meter and the data gatherer, the distance between the meter and the receiving radio unit has to be kept short. Thus, if a  
25 direct radio link between the meter and the data gatherer is desired, the data gatherers need to be located close to the meters. High power radio links enabling longer transmission lengths may not be used since it may be difficult to obtain free bandwidth for the high power links. The interference  
30 caused by the high power links might not be tolerated by other radio communication systems. In addition, if a large number of various domestic meters and other appliances want to use the information transmission facility, this may imply a very large

total bandwidth requirement. This may cause a problem for any long range radio communication system as these are typically provided with only a limited capacity. Low power radio links cause less interference and the load may be distributed to several local radio systems. However, the use thereof is limited by the restricted operational range.

Intermediate transceivers have also been proposed to enable longer distances between the meters and the data gatherers and/or access points to a public telecommunication system. The intermediate transceivers are arranged close enough to the meters to receive the low power transmission therefrom and to forward the information to a data gathering node through an appropriate communication media. The intermediate transceivers may act as a hub, i.e. receive read-out data from several meters, combine the received data to a message and transmit the data through a communication channel to the data gatherer, thereby saving the resources of the communication media.

GB patent application 2297663 discloses a system for the remote reading of on-site meters using a radio link between various meters at the utility commodity consumer and a central reading unit. The on-site reading unit is fixedly located at the consumer's premises or in close proximity thereto. The reading unit is linked to a telecommunications network via a telephone line. The read-out data is transmitted via the telecommunications network to a data collection point for further processing. Although a low power radio link is employed between the meters and the reading unit, the system still requires an existing telecommunications line between the fixedly located reading unit and the telecommunications network. In addition, the consumer has to obtain and pay for two dedicated radio apparatus, one for the meter and one for

the reading unit. Thus several dedicated interfaces are required, adding to the complexity and cost of the system.

5 In the earlier proposals each consumer entity may need to obtain dedicated transmitters, receivers and interface devices. Where the intermediate devices are shared by several consumers, each of the consumers still needs to pay their share for the dedicated intermediate devices. Therefore the use of the intermediate devices for improving the usability of  
10 the low power radio links may increase the complexity and cost of the remote meter reading beyond a level that is competitive when compared to manual reading of the meters.

If a public land mobile network (PLMN) is used directly for  
15 the communication between the meter and the data gatherer, radio devices are required that are dedicated for the particular PLMN standard and communication protocols to be used. In practice this means that the meter needs to have a transmitter that is configured in accordance with the standard  
20 of the particular mobile telephone network. The meter must also subscribe to the mobile telephone network in order to be able to use the networks for the communication. These may make the infrastructure too complicated and expensive to implement and operate.

25

The above discussed the transmission of the read-out data of the meters to a data gatherer entity. However, it could also be useful to be able to have a simple and cost efficient system for transmitting data towards the meter or another on-  
30 site controller of a utility commodity system. The data could include, for example, control or maintenance instructions, configuration or tariff information and different update information, general enquiries and so on.

In addition to devices that associate with the utility commodity system, various other devices may also need to be enabled to receive and/or transmit control information from a remote device. For example, a household or an office may include different electronically controlled domestic appliances such as microwave ovens, electric ovens, refrigerators, washing machines, CD and video players, stereos, TVs, central heating systems, lightning systems, personal computers and so on.

The skilled person knows several different ways to control a device. For example, a device may be switched between 'on' and 'off' states. The operation of a device may also be adjusted in a desired manner, e.g. a central heating system may be adjusted to produce more or less heat, a freezer may be adjusted to become more or less cold, a video player can be programmed to record a TV program and so on. In addition to directly influencing the operation of a device, the control may also include procedures such as monitoring the operation or status of the device and/or collecting various information (such as diagnostic information, status information or environmental information) about the device and/or operation thereof and/or the operation environment thereof. An example is a status indicator light that indicates whether a device, such as a washing machine or a TV, is on or off and/or performing a any task at a given moment. Another specific example is an alarm system where an alarm signal is given subsequent to a predefined event, such as in the event of fire, burglary, water leak, failure and so on.

In some occasions it could desirable to be able to control a device, e.g. a household appliance, from a remote location



7 = *low maintenance*  
= *remote units*

while not being on-site, e.g. when being away from home. In addition, it may be desired to be able to sent control information such as software updates, maintenance instructions and announcements to a device from a central controller entity. The user or the remote central control entity may also wish to receive control information, such as status information or usage information, from said device.

### Summary of the Invention

The embodiments of the present invention aim to address one or several of the above problems and to provide a feasible solution for communication of information between an on-site controller and a remote control entity.

According to one aspect of the present invention, there is provided a method for communication between an on-site controller of a utility commodity system and a remote data processing unit associated with the utility commodity system, wherein the on-site controller is associated with a wireless module, the remote unit is provided with a connection to a telecommunications system that provides wireless communication for a plurality of mobile stations, and each mobile station of the plurality of mobile stations is enabled to communicate with the wireless module, the method comprising: detecting that a mobile station of said plurality of mobile stations is located such that it is possible to establish a wireless link in accordance with a first wireless mode between the wireless module and said mobile station; and upon detection of the possibility for the wireless link, transmitting information between the controller and the remote unit via a first wireless link that is established in accordance with the first wireless mode between the wireless module and the mobile

station and a second wireless link between the mobile station and the wireless telecommunication system, said second wireless link being based on a second wireless mode, wherein the mobile station acts as a gateway between the first and  
5 second wireless links.

In accordance with more specific embodiments, the first wireless link may comprise a short range radio link between the mobile station and the wireless module. The first wireless  
10 link may be based on at least one unlicensed radio frequency band. The first wireless link may employ frequency hopping. The transmissions may include packet data. The frequency of transmission via the first wireless link may be changed between the subsequent data packets. The first wireless link  
15 may be based on a short range radio link protocol that is defined by Bluetooth Special Interest Group (SIG). Information may be transmitted from the on-site controller to the remote data processing unit and/or from the remote data processing unit to the on-site controller.

20

The wireless module that associates with the on-site controller or the wireless module of the mobile station may detect that a wireless link has become available.

25 The on-site controller may comprise a meter for metering the consumption of the utility commodity. The information may comprise the reading of the meter.

Information may be transmitted between a first wireless local  
30 network and a second local wireless network, wherein the wireless module that associates with the on-site controller belongs to the second local network and the information to be transmitted originates from the first local network.

According to another aspect of the present invention there is provided an arrangement for a utility commodity system, the arrangement comprising: an on-site control unit for  
5 controlling at least one function of the utility commodity system at a location of consumption of the utility commodity; a wireless module associated with the on-site control unit, the wireless module being arranged to operate in accordance with a first wireless mode; a telecommunications system  
10 arranged to provide wireless communication for a plurality of mobile stations in accordance with a second wireless mode; a remote processing unit for managing at least one function of the utility commodity supply system, said remote processing unit being connected to the telecommunications system; a  
15 plurality of mobile stations subscribing to the telecommunications system, each of the mobile stations being arranged to transmit and receive signals in accordance with the first and the second wireless modes and to provide a gateway between said two transmission modes; detector means  
20 for detecting that a mobile station of the plurality of mobile stations is located such that it is possible to have a wireless link between said mobile station and the wireless module, the arrangement being such that upon detection of the possibility for the wireless link information may be  
25 transmitted between the on-site control unit and the remote unit via a wireless link between the wireless module and the mobile station in accordance with the first wireless mode and a further wireless link in accordance with the second wireless mode.

30

According to another aspect of the present invention there is provided an on-site controller for controlling at least one function of a utility commodity system, comprising a

transceiver module for enabling wireless transmission from and to the on-site controller in accordance with a short range radio link protocol, the module being adapted to detect that a mobile station of a plurality of mobile stations is located such that a short range radio link may be established between the mobile station and the wireless module, wherein the arrangement is such that upon said detection a short range radio link may be established and information may be transmitted between the on-site controller and the mobile station.

According to another aspect of the present invention there is provided a method of transmitting control information between a device and a remote control entity, wherein said remote control entity is connected to a telecommunications system and said telecommunications system serves a plurality of mobile stations, the method comprising: detecting that a mobile station of said plurality of mobile stations is located such that a wireless link in accordance with a first transmission mode can be established between communication means of the device and said mobile station; setting up a first wireless link between the device and said mobile station; transmitting control information between the device and said mobile station via the first wireless link and via a second wireless link that is established in accordance with a second transmission mode between said mobile station and the telecommunication system, wherein said mobile station provides a gateway function between the different wireless links.

The embodiments of the invention may provide a cost efficient and flexible system for communication between an on-site device such as a controller of a utility commodity system or any other domestic appliance and a remote unit. The amount

and/or cost of equipment the consumer needs to obtain for the purposes of communication may be minimised. The communication arrangement may utilise the resources of a high volume telecommunications system without the requirement for the consumer to subscribe to the telecommunications system. The communication may not cause any significant interference to other radio devices.

#### Brief Description of Drawings

10

For better understanding of the present invention, reference will now be made by way of example to the accompanying drawings in which:

15       Figure 1 shows one embodiment of the present invention; Figure 2 shows the service areas of two local wireless services and a national cellular network;

Figure 3 is a flowchart illustrating the operation of one embodiment of the present invention; and

20       Figures 4 to 8 show further embodiments.

#### Description of Preferred Embodiments of the Invention

Reference is made to Figure 1 which shows an embodiment of the present invention, and more particularly an embodiment that relates to an electric power supply system for domestic appliances 1 to 3. Said appliances are located within a dashed line 16 indicative of a household. It should be appreciated that although a washing machine 1, a refrigerator 2 and a light bulb 3 are shown in Figure 1, the term 'domestic appliance' may refer to any electrically powered device. The exemplifying appliances 1 to 3 are connected by a conventional internal electricity network 5 to an electricity meter 10 in

manner known by the skilled person. The meter 10 is connected further by wiring 7 to a transformer 6 that is typically located outside the house 16. The transformer 6 is connected further by a connection 8 to a high voltage electric power network 9.

The operation of an electric power supply system is well known, and will not be described in more detail herein. It is sufficient to note that typically the electric power in the high voltage network 9 is transformed by the transformer 6 to a lower voltage level so that it can be used by the domestic appliances. The electric power supplied from the transformer 6 into the household 16 will flow through the meter 10. The electric power is distributed via the wiring 5 to the various domestic appliances within the household 16. Whenever electricity is consumed, the meter 10 meters the flow of electricity i.e. the amount that is consumed by the domestic appliances. The meter may also incorporate some other control functions, such as fuses and/or timer arrangements.

The meter 10 of Figure 1 provides an on-site controller that may provide various control functions relating to the inflow, distribution and consumption of electricity within the household 16. The controller 10 may include a display 13 for displaying the amount of electricity that has been consumed in appropriate units, such as kilowatthours and/or other information. Should the control unit 10 be a conventional electricity meter, the display 13 would need to be read by somebody at predefined read-out intervals. However, instead of this, the control unit 10 of Figure 1 is provided with a remote meter reading function. More particularly, the control unit 10 is provided with a wireless module 11 and antenna 12 for wirelessly transmitting and/or receiving radio frequency

signals so that reading information may be communicated to a remote data processing unit 14 of the system.

A more detailed description of appropriate wireless modules for enabling the communication from and to the controller as well as of the various types of information that may be communicated between the controller 10 and the remote unit 14 will be given later after a brief description of the other elements of the communication arrangement of Figure 1.

A part of a public land mobile network (PLMN) 31 is shown in a somewhat simplified form on the right hand side of Figures 1 and 2. The public land mobile network may comprise a cellular telecommunication system that is based around cells or similar radio coverage areas. Examples of cellular telecommunications systems, without limitation to these, include standards such as GSM (Global System for Mobile communications) or various GSM based systems (such as GPRS: General Packet Radio Service), AMPS (American Mobile Phone System), DAMPS (Digital AMPS), WCDMA (Wideband Code Division Multiple Access) or CDMA in UMTS (Universal Mobile Telecommunications System), IMT 2000, i-Mode and so on. The chosen standard sets out the elements required by the network, the functions of the elements and the communication protocols to be used for communication between the various network elements and the mobile stations.

A base transceiver station (BTS) 22 serves mobile stations (MS) 20 or other similar user equipment (UE) via a wireless interface or link 21. It is noted that for clarity reasons Figure 1 shows only one base station and one mobile station. A typical PLMN system would comprise a number of base stations. A number of mobile stations may communicate with each of the

base stations. The base station may sometimes be referred to as Node B.

The base station 22 may be controlled by an appropriate  
5 controller apparatus. For example, in a WCDMA radio access network a cell is served by a base station that is controlled by a radio network controller (RNC; not shown). In a GSM based network a base station may be connected to and controlled by a base station controller (BSC; not shown). The BSC or RNC node  
10 may be, in turn, connected to and controlled by a network entity such as a mobile switching centre (MSC) 24. In some applications the base station 22 may be controlled directly by the mobile switching centre MSC 24. Since the mobile station 20 is connected to the base station 22, this means that the  
15 mobile station 20 that is served by the base station 22 may also be under the control of the controller 24 of the PLMN system 31. Typically the number of controllers in a public land mobile network (PLMN) is greater than one. The controllers may also be interconnected. It is also noted that  
20 a mobile station may be in communication with two or more base stations at the same time. The two or more base stations may be connected to the same controller entity or different controllers. The skilled person is familiar with the basic principles of a PLMN communication system, and therefore the  
25 cellular system is not explained in any more detail.

A PLMN is typically provided with one or more gateway nodes for connecting the mobile network 31 to other communication networks, such as to a public switched telephone network  
30 (PSTN; not shown) or to a data network. Examples of gateway nodes include a Gateway GPRS support node (GGSN) and a Gateway MSC (GMSC). Examples of data networks include a X.25 based network or an IP (Internet Protocol) based data network.



Figure 1 shows a gateway node 26 which connects the mobile network to a packet switched Internet Protocol network 28.

The mobile station 20 is typically a wireless transceiver terminal that is adapted to operate in accordance with one or several cellular network standards or other standard providing wireless communication (such as Digital European Cordless Telephone (DECT) or Wireless Intranet Office (WIO)). A mobile station that may operate in more than one communication system is often referred to as a multi-mode station. An example of the multi-mode mobile station is the so called dual-mode mobile telephone that may communicate in accordance with two different standards. The operation of a conventional mobile station, such as the cellular telephone 20 of Figure 1 is well known; and will thus not be explained in more detail.

In addition to the provision of communication services, the mobile station may also comprise a data processing entity. That is, the mobile station may provide the user thereof with a mobile data processing facility that may be connected to remote data processing units, such as Internet servers, via a wireless connection. Figure 2 shows such an advanced mobile station provided with a larger display and a keypad. This type of mobile station provides the user with many sophisticated services and a more sophisticated interface than what an ordinary mobile telephone may provide, e.g. facilitating easier selection among different options or input of textual instructions. The user may also send and receive emails, contact and browse world wide web (WWW) documents in remote WWW servers over the Internet, and so on. The use of the sophisticated mobile stations is predicted to increase remarkably after so called packet switched mobile services or

the 3<sup>rd</sup> generation services, such as the GPRS or the UMTS, have been introduced.

The mobile station 20 is also arranged to operate in accordance with a communication protocol that provides a local low power wireless service. The local wireless service is preferably independent from the standard and protocols of the PLMN network the mobile station 20 subscribes to. The mobile station 20 may be provided with a low power radio or wireless module 19. The low power radio service of the embodiment can be defined as a unlicensed radio service that provides a low power wireless link or short range radio link (SRRL) between any two stations which are provided with appropriate wireless modules and are within a range of each other. In Figure 2 the wireless modules of the mobile station 20 and the controller 10 both provide a local wireless service area 32 and 33, respectively. The wireless modules 19 and 11, respectively, are both within a common wireless service area 34, whereby duplex traffic between the wireless modules 19 and 11 is enabled.

The PLMN system 31 covers a substantially large geographical area, and thus the boundary of the service area thereof is not shown. The mobile stations 35 may communicate with the PLMN in a usual manner. However, since the mobile stations 35 are located outside the range 33 of the wireless module 11 of the meter 10, they cannot be detected by the wireless module 11 and it is not possible to establish a low power wireless link between any of the mobile stations 35 and the module 11. Should one of the mobile stations 35 move within the range 33, then the station may be detected by the wireless module 11 and subsequently used for communication, as will be explained below.

In the embodiments of the present invention, the arrangement may be such that the mobile station 20 of the plurality of mobile stations 20, 35 subscribing to the PLMN 31 offers a local low power service for the other co-operative stations within the range 32 thereof. As is shown by the flow chart of Figure 3, when the wireless module 11 associated with the controller 10 detects that the local low power service has been offered, the module 11 may respond to the offer and request for a data transmission link 18 between it and the mobile station 20. Before the request is sent, the controller may check whether there is any need to transmit data to avoid the establishment of any unnecessary short range wireless links. If the offer for local service is made by the radio module 11 of the controller 10, then the mobile station 20 detects the offer and initiates the procedure to setup a low power radio link between the two stations.

The short range low power wireless service operates preferably in a unlicensed frequency range, such as in frequencies over 2 GHz. For example, in the USA unlicensed ISM bands 2.4 to 2.5 GHz and 5.725 to 5.875 GHz are permitted. Instead of using tailored radio stations for the elements 11 and 19, the wireless modules 11 and 19 of the controller 10 and the mobile station 20, respectively, are preferably based on standardised low power radio service components that may be mounted on or be an integral part of the controller and the mobile station, respectively. An example of an appropriate local low power wireless service that may be used for implementing the embodiments is provided in accordance with a Bluetooth™ protocol. The following will describe in more detail this exemplifying unlicensed low power wireless service.

The term Bluetooth™ refers to a technology specification by the Bluetooth special interest group (SIG) for small factor, low-cost, short range radio links (SRRL) between mobile stations, mobile personal computers, and other portable devices. The Bluetooth™ protocol defines a universal unlicensed local wireless service where the wireless modules operate in an unlicensed ISM band at 2.4 GHz. The 2.4 GHz frequency bandwidth is globally available and thus a Bluetooth™ wireless link is believed to be compatible world-wide for local wireless communication. A device equipped with a Bluetooth™ wireless module may establish an instant connection with another device provided with a Bluetooth™ wireless module as soon as the other wireless module comes within the range of the first device. The Bluetooth™ technology allows for a replacement of many proprietary cables that conventionally have connected portable and/or stationary devices to each other with a universal short range radio link. The connection may be established and maintained even when the devices are not within line of sight. The range of each radio service area can be, for example about 10 meters, but the range can be extended to around 100 meters, e.g. by use of an appropriate amplifier.

The Bluetooth™ specification defines a fast acknowledgement and frequency hopping scheme to improve the robustness of the wireless link and to combat interference and fading. Bluetooth™ wireless modules avoid interference from other signals by hopping to a new frequency after transmitting or receiving a data packet. The use of short data packets and fast hopping is also advantageous since it may limit the impact of other devices such as microwave ovens or TVs. Forward error corrections (FEC) may also be used. FEC limits the impact of random noise on long distance links. The

encoding of the messages may be optimised for an uncoordinated environment. A shaped, binary FM modulation is applied to minimise the complexity of the transceiver of the wireless module.

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Bluetooth™ facilitates real-time voice and data transmissions. The gross data rate of the present Bluetooth™ applications is 1MB per second. The Bluetooth™ basement protocol is a combination of circuit and packet switching. Slots can be reserved for synchronised packets. A packet nominally covers a single slot, but can be extended to cover up to five slots, or even more. At present the Bluetooth™ radio service can support an asynchronous data channel, up to three simultaneous synchronised voice channels or a channel which simultaneously supports asynchronous data and synchronised voice. At present each voice channel may support a 64 kb/s synchronous link. At present the asynchronous channel can support an asymmetric link of 721 kb/s in either direction while permitting 57.6 kb/s in the return direction, or a 432.6 kb/s symmetric link. A time division duplex scheme may be used for full duplex transmission.

A Bluetooth™ based local wireless service is advantageous for several reasons. The network topology of the Bluetooth™ system may support both point-to-point and point-to-multipoint connections, thereby enabling communication between several devices at the same time. The size of the device required to implement a wireless module is small and typically comprises a single chip. Therefore the implementation costs of a wireless module are relatively low. The power consumption of a Bluetooth™ arrangement is also low. The fast frequency hopping scheme enables robust radio links.

As shown in Figures 1 and 2, the mobile station 20 may be provided with a Bluetooth™ chip 19. The chip 19 comprises processors, a radio part and so on. The controller unit 10 of the power supply system 30 is also provided with a  
5 corresponding Bluetooth™ chip 11. Thus it is possible to establish a low power radio frequency connection in accordance with the Bluetooth™ remote user interface protocol between the devices 10 and 20.

10 The meter 10 may interact in various manners by means of the mobile station and Bluetooth™ link. According to an embodiment, the Bluetooth™ provides a transparent WAP (wireless application protocol) stack capability so that the meter may generate a standardised WAP packet for the  
15 Bluetooth™ and the mobile station to transport the information to the gateway 26. In the gateway 26 the WAP message may be converted into IP (Internet Protocol) data packets.

The Bluetooth™ may also provide a service that is analogous to  
20 a conventional modem. In this option the meter 10 must generate a telephone number (or an equivalent address) and interact with an appropriate call establishment protocol. The call would be made to an equivalent of an ISP (Internet Service Provider; not shown) which would provide the Internet  
25 access point for the meter, instead of the gateway 26. A possibility is that the meter is aware of the elements in the link between it and the remote data processing unit 14. The meter may use a specific protocol to establish communication with the mobile station 20 and then request an SMS (short  
30 message service) or similar service to send the data to the data processing unit.

The system of Figure 1 includes further a remote data processing unit 14. The remote unit 14 collects data concerning the power supply system in its database 15. The data may include read-out information from the control unit 10 and/or any other data that is required e.g. for the management of the utility system and/or individual controllers 10. The remote data processing unit for the collection and processing of data may be any appropriate device that is capable of handling data associated with the utility commodity supply system 30. The remote unit 14 may be owned and run by the electricity company, but other arrangements are also possible. For example, instead of being a part of the utility commodity supply system 30, the remote unit may be an element that is implemented within the public land mobile network 31 or the remote unit 14 may be owned and run by a separate service provider providing utility commodity supply system management services. The remote unit 14 may also be a general purpose data formatter/forwarder. The data processing device may also be accessed by other organisations than the utility company and/or service provider. Different organisations may want to access e.g. to the raw electricity consumption data, i.e. the data may not be accessed just for the billing purposes but e.g. for network planning and maintenance, generation monitoring and so on.

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The remote unit 14 is connected to the data network 28 by an appropriate interface 34. The connection to the PLMN 31 is then provided via the data networks 28 and the gateway 26. The remote data processing unit may also be connected to other elements of the commodity system 30. In addition to gathering and processing data received from the control unit 10, the data processing unit 14 may accomplish various other functions such as general utility commodity system management.

The communication between the on-site controller 10 and the remote unit 14 may also include other information than the meter reading. In general, information sent from the on-site controller 10 to the remote data processing unit 14 may be any routine information provided by the on-site controller and/or any sporadic information provided by the controller. Thus, in addition to raw consumption data, any 'secondary' information such as processed consumption data (e.g. consumption patterns) may be communicated. The information may also include (either from the meter or any other household appliance that is capable of passing the information to the on-site controller) servicing notification and/or requirements, usage information and/or statistics, diagnostic information, internal operation information, information of any attempts to tamper with the meter, information that the meter may have gathered on interruption to the power supply or on voltage dips and so on. In addition, the information may comprise other environmental information, such as the temperature, which might be of use to the electricity supplier. The 'secondary' information may be useful, for example, in planning and maintaining the utility system.

The remote unit 14 may also communicate towards the controller 10 over the public land mobile network 31 and the local wireless service 32. The communication may comprise any routine information and/or sporadic information required by the on-site controller. Control instructions may also be sent to the controller 10. The control information to be transmitted to the meter 10 may comprise, for example, direct load switching instructions (e.g. switch off power to a water or central heating system during a peak in the electricity demand). The information may comprise tariff information so



that the suppliers may remotely change the tariffs (i.e. charge rate switching information). This enables the suppliers to offer a variety of tariffs and to change the tariffs in regular or irregular intervals without a need to physically visit the meter, thereby providing a greater flexibility in the pricing of the consumption. The consumers may also be provided with energy cost information (i.e. non tariff specific information). Billing information to allow a true money display may also be provided e.g. by means of the display 13. The information to the controller 10 may also comprise external control information (e.g. for the purposes of heating load switching). Software updates, maintenance instructions, configuration information (for example, for disabling the above described power switching) or any other instructions may also be sent. The information may also be sent either to the meter or to an appliance that may communicate with the on-site controller.

Referring now also to the flowchart of Figure 3, the data transmission arrangement may be such that the wireless module 11 of the controller unit 10 monitors continuously if a mobile station with a co-operational wireless module has entered the short range radio link service area 33 (see Figure 2) of the wireless module 11. After a mobile station 20 with a co-operative module 19 has entered a Bluetooth™ 'piconet' 33 of the module 11, and upon detection of the mobile station 20, the controller 10 may send an initial enquiry concerning the services provided by the detected mobile station. The detection may be based on a Bluetooth™ 'broadcast and join the piconet' protocol. The mobile station 20 receives the enquiry and provides a response. If the mobile station 20 is capable of transmitting data from the meter 10 towards the mobile network 31, it will transmit a response to the metering unit

10 acknowledging this. The response may also indicate the type of service the mobile station is capable of providing (e.g. WAP messages, SMS messages, a modem connection and so on). The meter may then request for a data connection. The mobile  
5 station may acknowledge that a connection has been established before the actual data transmission is initiated, e.g. by sending a confirmation message that a connection to the remote unit 14 over the Internet 28 has been established. Data will be transmitted between the controller 10 and the mobile  
10 station 20 via the established short range radio link. The controller 10 may send standardised packets (e.g. using normal IP addressing process). The controller 10 may also send a specific data packet that request communication with the utility system's computer 14. The utility system's computer  
15 may also acknowledge the establishment of the link. It should be appreciated that the above are only examples of the various steps, and that communication establishment may include less or more steps than above. The further steps may include e.g. various further acknowledgements and/or control signalling.  
20 This is, however, an implementation issue, and will not be discussed in more detail herein.

It should be appreciated that the detection of an existing other co-operative short range radio device may also be  
25 accomplished by the mobile station 20. In accordance with one alternative it may be either the controller 10 or the mobile station 20 which sends the initial request, depending on which one of the devices detects the other device first.

30 After the mobile station 20 has received the data from the controller unit 10, it will forward the data towards the base station 22 over the PLMN radio link 21. In the public land mobile network (PLMN) 31 the data will then be forwarded in a

known manner from the base station 22 to the gateway node 26 and further to the data network 28.

The controller 10 is preferably provided with an appropriate identifier (ID). The controller ID may be transmitted whenever the controller 10 communicates towards the remote unit 14. The remote unit 14 may identify the controller based on the identification. In addition, the remote unit 14 may use the controller ID for routing any transmission therefrom to the controller. The controller identities may be stored in the database 15 of the unit 14.

There is a number of possibilities for the controller ID. For example, since the meters typically have a unique identification (serial) number, this could be used in here. It is possible to arrange the system such that the lower levels of the communication protocol do not use the controller serial number information. Instead, the lower levels may use e.g. an IP address of the controller 10 or a PLMN/PSTN phone number assigned to the controller. A temporary ID may be dynamically or transitorily allocated for the connection from a limited number of temporary or lower level identifiers. The controller (or other device) may be defined only by a type and a unique ID is used only for the purpose of the communication. If a temporarily allocated ID is used, the negotiation for the connection is based on the temporary ID, and the controller may be identified later during the established connection e.g. by means of the serial number thereof. Some form of messaging specific (e.g. SMS) identifier may also be used. If the communications channel is only opened up using a specific (e.g. the householder's) telephone number then the addressing of the controller may be based on use of a derivative number.

For example, the communication may be addressed to appliance No. 3 on telephone number 0468 104072.

The communication between the data server 14 and the on-site control unit 10 may comprise packet data. If the used PLMN system 31 enables packet switched transmission, then the mobile station 20 may transmit the received data packets to the remote data unit 14 over the mobile network 31 and/or packet switched data network 28. If any modulation is required in the transmission path between the controller 10 and the remote unit 14, this may be accomplished by the gateway apparatus interfacing the different systems. The function of the gateway apparatus is to convert the information in a transmission format to another transmission format. In Figure 1 a gateway function may be required at the mobile station 20 in addition to the gateway 26. A further gateway may be required between the data network 28 and the remote unit 14, e.g. if the remote unit 14 is connected to a local area network (LAN) or wireless LAN (WLAN).

The transmission of data between the controller 10 and the remote data processing unit 14 may be based on wireless application protocol (WAP). A mobile station provided with WAP facility may receive the data from the controller 10 in an appropriate format and forward it in a WAP format towards the telecommunication system 31 and vice versa. The WAP station may incorporate a modem and it may be adapted to establish a connection to an appropriate ISP to access the Internet. The WAP may also be supported by the short range radio link 18 and the controller 10, i.e. the controller may be adapted to generate and/or receive WAP messages, while the mobile station 20 acts as a forwarding/routing gateway between the controller and the appropriate network element. In an embodiment the

generation / interpretation means of the controller 10 may comprise a processor 17 provided with WAP compatible software

A possibility is to transmit the data in a SMS (Short Message Service) message format. Most of the present PLMN systems are capable of handling SMS messages and transmitting them to the remote data unit 14 or data server. The data server may then interpret the text message containing e.g. the controller ID and read-out information. The SMS message may thus be, for example, a text message '1000AA87-123456', wherein the first part of the message identifies the controller 10 and the second part indicates the reading in a numerical value. The message may also include some additional information, such as the time when the reading was taken. According to one possibility a time-stamp is added to the message by the PLMN system 31, e.g. by the mobile station 20 or by the SMS element (not shown) of the PLMN. If SMS messages are used, the controller 10 and the remote unit 14 are preferably provided with appropriate means 17 and 29, respectively, for generating and/or interpreting the SMS messages.

It is possible that the mobile station or another element of the PLMN system performs at least some type of modification of the received WAP, SMS or any other message before forwarding the message. The mobile station may, for example, transform a message in a first format from the controller 10 into a wireless application protocol (WAP) format and transmit the information in the WAP format towards the remote unit 14 and vice versa. It should be appreciated that in addition to the above referred WAP and SMS formats, the data may be sent in any suitable format.

The transmission of information between the controller unit 10 and the remote unit 14 may be parasitic, i.e. transparent for the user of the mobile station 20. In other words, the user of the mobile station 20 may not be aware of the transmission of data between the unit 10 and the base station 22. The mobile station may be used for transferring only small amounts of data rather than provide a capability to be a conventional modem for a data processing device to access the IP network 28. This may enable free transmission of the messages, i.e. the parasitic transmission. The parasitic nature of the transmission means also that the mobile station 20 may be any mobile station of a plurality of mobile stations provided with appropriate wireless module 19. As explained above, the wireless module 19 of the mobile station 20 and the wireless module 11 of the controller unit 10 are capable of discovering the existence of a co-operational wireless device within the service range thereof and thereafter to establish a radio link to said co-operational device. Any mobile station provided with the wireless module 19 may thus be used for the transmission of information between the controller unit 10 and the remote unit 14.

The local wireless service is preferably independent of the standard of the public land mobile network system 31. That is, the radio link 18 in accordance with the local wireless service protocol of the wireless module 11 of the controller 10 may be used for the communication between the module 11 and the module 19 of the mobile station 20 regardless of the standard and/or communication protocol(s) used for the radio link 21 between the mobile station 20 and the base station 22.

As discussed above, the transmission between the control unit 10 and the base station 22 may be transparent for the user of

the mobile unit 20. The mobile station 20 acts as a relay between the wireless module 11 and the base station 22. The connection time and/or reserved packet data resources may be charged to the holder of the remote unit 14, and thus the owner of the subscription of the mobile station 20 may not become responsible for the costs for the transmissions. The short range radio link service 32 and 33 may be free of charge, although a charging scheme for the links between the controller 10 and the mobile station 20 may be desired in some applications. For example, the communication service may be charged from the consumer e.g. in a package deal offered by the operator of the PLMN (e.g. by an annual fee). A possibility is to make the communication service a part of a general pay per data situation. For example, the costs for the user of the mobile station may be recompensed by a discounted bill from the utility company.

The penetration of mobile stations, such as mobile phones and portable data processing devices provided with radio transceivers, is already high in many countries, and the number of mobile stations is believed to increase further. Therefore it is likely that at least one mobile station of the number of mobile stations 20, 35 provided with the local wireless service facility 19 will be at some stage within the range 33 of the control unit 10. However, different schemes for the initiation of data transmission may be used in different areas in order to optimise the data collection procedures.

The amount of data produced and/or required by the on-site controller (and more precisely, the meter and/or any domestic appliance) may be relatively low and so, provided the frequency of messaging is not especially high, communication

can be comprehensive (i.e. cover e.g. all meters) without a significant impact on the overall loading of the communication system.

- 5 It may be desired to reduce the potential impact further, either by active management by the network operator (e.g. by selectively disabling the service provision in the mobile stations) or by the utility system which may abort conversations before any data is transferred.

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The data transmissions between the controller 10 and the remote data unit 14 may also be limited by defining time periods when information may be sent from and/or to the controller 10. The controller 10 may be provided with a timer  
15 that triggers an active transmission mode in predefined time intervals, such as once a month for a predefined length. When the wireless module 11 of the controller 10 is in an inactive mode, it will not search for a device provided with a co-operative wireless module 19. According to one possibility the  
20 control unit 10 will deactivate the transmission function thereof for a predefined period as soon as it receives an acknowledgement that the latest information sent by it has been received by the remote unit 14. The controller or an appliance/meter associated with it may also apply some  
25 decision algorithm to determine when information should be transmitted. This may even be a fairly complex set of rules compounding of a frequency of a call factor, a factor related to the amount of data to be transferred and assigned days of the week or times of day. Internal conditions may also be used  
30 which could override the routine call basis. These might include data overflow, internal failures, service requirements, reconfiguration or updates requests made by the customer and so on.



The frequency of the 'visits' by the co-operative mobile stations within the local wireless service area 33 of the on-site controller 10 will depend the location of the on-site controller. Therefore differently located control units may be provided with different timing schemes. For example in densely populated urban areas the control unit may search for suitable mobile stations for a substantially short period of time, whereas in the rural areas the period may be substantially longer. Different data collection classes may be defined for different areas and/or different consumers.

It is also possible to employ data transmission "agents". That is, the system makes use of such mobile stations that visit the consumer entity on a regular basis. The agent may be a person such a postman, the householder, or a local bus driving past the household at frequent intervals. An advantage of using agents is that the location and/or management of limited number of possible stations may be easier than if all possible mobile stations are used for the data transmission.

The initiative to send information to the controller 10 may come from the controller 10, the mobile station 20, the telephone network 31 or the remote data processing unit 14. The wireless module 19 of the mobile station 20 or the mobile station itself may comprise a 'phone home' function for initiating the connection. The system may be set up to use only selected mobile stations for the transmission towards the controller (e.g. the householder's and/or the agent's mobile stations). The network operator may provide a geographically (e.g. cell based) call up capability.

If the remote unit 14 needs to send data towards the control unit 10, it may be desired to be able to define a time when it may be possible to communicate with the controller. According to one possibility the mobile stations send reports concerning the controllers they have been in contact with. These reports may be stored in a temporary database of the mobile network or the remote management unit 14. Various timing schemes may be used for the reporting. Connection history of an on-site controller may be stored in an appropriate database (e.g. in the database 15). The information of the previous connections may be used to predict when a mobile station should be within the range 33 of the wireless module 11 of the controller. The database may also include other information, such as a rough timetable of the agent referred to above. Based on the information in the database, the system may make an intelligent guess concerning the timing when it could have good chances to make a contact with the controller unit.

The PLMN system may also send so called flood paging towards all, or selected mobile stations and indicate in the page message that data is to be transmitted towards one or several on-site controllers. The paging may be broadcast only by those base stations that are known to cover the geographical area where the on-site controller is located. However, the flood paging may in some instances consume unnecessarily the network resources. Therefore it may be advantageous to be able to locate those mobile stations that have at least a theoretical chance of getting close enough to the controller.

According to an embodiment the remote unit 14 requests the mobile network 31 to select a mobile station (or several stations) which is within a predefined range from the controller 10. If the PLMN system 31 is a cellular radio

network, the network knows at least roughly the location of the mobile stations 20, 35 connected thereto. The mobile network returns the identities of such mobile stations which are within the predefined range whereafter the remote data unit may send the data to these mobile stations with instructions to search for the control unit 10. A straightforward solution for the location of the mobile stations is based on information that is available in the home location registers of the mobile stations. A location services (LCS) node providing location services for different applications or clients may also be used for this. In general terms, the LCS node can be defined as an entity capable of providing information concerning the geographical location of a mobile station, and more particularly, the geographical location defined on the basis of the position of the mobile station relative to the base station(s) of the mobile telecommunications network. A more specific description of a location service can be found e.g. from ETSI (European telecommunications Standards Institute) technical specification "Location Services" (3GPP TS23.171 and GSM 03.71).

According to another embodiment the remote data unit sends a request to the mobile network to search for the control unit 10. The controllers of the mobile network will then instruct the mobile stations within a predefined range from the requested control unit 10 to search for the wireless module of said control unit. After a mobile station locates the control unit 10, it will send a message to the responsible network element of the network 31 acknowledging that it may make contact with the controller 10. Thereafter a message is sent to the remote management unit 14 that information may be transmitted towards the control unit 10. The management unit

14 may have already transmitted this information to the mobile network 31. The information will be forwarded to an appropriate mobile station 20 upon discovery of the control unit 10.

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As is also disclosed by Figure 2, the household appliances 1 to 3 are located within the local wireless service area of the controller 10, i.e. they belong to the same piconet as the controller 10. Therefore it is possible to use the messaging path between the controller and a remote unit also for communication between the appliances 1 to 3 and the remote control unit 14. In addition to the appliances, the controller 10 may communicate with controllers of other utilities, and transmit, for example, a combined report of the consumption of the different utility commodities. The data may then be distributed either at the telecommunication network 31 or at the data processing unit 14 to appropriate service providers for predefined purposes, such as for billing.

20 The information to be transmitted to the appliances may comprise application/appliance specific information, such as recipe information to a microwave or advertisements to appliances. For example, if a washing machine or microwave has a some form of general purpose display then it is possible to display e.g. text messages such as 'XYZ washes whiter' or 'Special offer: ABC's microwave ready pizza - £3.49'. The text may also be scrolled round in the display, even if the appliance is in an inactive state.

30 A further embodiment allows the consumer to read his own meter via the data network. For example, the consumer may use an Internet connection and a web browser for obtaining the latest reading information or other data concerning the consumption

of the utility. The remote unit 14 may be arranged to include the metering data with some form of standardised web page or WAP page (if a WAP telephone is preferred) format before making it available for the consumer.

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Figure 4 discloses a further embodiment in which a mobile station 20 transmits a further local wireless service message 18' to another mobile station 20' which then forwards the message to a base station 22. In other words the message is transmitted in hops from the wireless module 11 of the control unit 10 to the wireless module 19 of the first mobile station 20 and then to the wireless module 19' of the second mobile station, where from it is forwarded to the base station 22 of the mobile network and further to the remote data processing unit.

According to a further embodiment shown by Figure 5, a household may be covered by several piconets, i.e. local short range radio link networks. The architecture of the several piconets may be, for example, such that household appliances and the electricity meter belong to a first piconet or appliance piconet 40. A second piconet 42 is provided for communication and/or control purposes (control piconet), the second piconet 42 of Figure 5 corresponding the short range radio link area 33 of Figure 2. The members of the appliance piconet 40 may communicate with each other by means of wireless modules 41 that associate with the respective devices 1. The communication between the various devices of the piconet may occur either directly between the devices or by "hopping" from a wireless module 41 of a device to another wireless module 41 of another device until the destination device is reached.

Although not shown, the communication or control piconet 42 may also employ the hopping scheme. The communication piconet 42 comprises a wireless module 11 that is capable of communication with the stations 20 of a telecommunication system. A gateway between the piconets may be provided between predefined devices of the respective piconets, such as between a microwave oven 43 of the first piconet 40 and the controller unit 10 of the second piconet 42. The meter (not shown in Figure 5) may be positioned in the appliance piconet 40. The meter may communicate towards the mobile station 20 such that it transmits the message to an appliance of the appliance piconet 40 that forwards the message to the second piconet 42. The second piconet 42 may then transmits the message towards the mobile station. The second piconet may be provided with a wireless module 11 that has a higher transmission power, thereby enabling a longer transmission range than what the wireless modules 41 of the first piconet 40 may provide. It should be understood that the number of the wireless short range subnetworks i.e. piconets may be greater than two.

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Reference is now made to Figure 6 which shows another embodiment of the present invention, and more particularly an embodiment that relates to control of domestic appliances 1 to 3. Figure 6 shows a central heating unit 1, a microwave oven 2 and a lightning system 3 that is controlled by an on-site switch unit 4. For clarity purposes, the central heating unit 1 will be described discussed in the following example as the device that is to be controlled by a remote controller entity 14, although any other domestic appliance could be controlled in a similar manner.

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More particularly, the central heating unit 1 is provided with a wireless module 11 for wirelessly transmitting and/or

receiving radio frequency signals from co-operative remote stations. The wireless module is connected to an electronic control unit 17 of the device 1, such a microprocessor, that controls the operation of the device 1 in a known manner.

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A remote data processing unit 14 provides a remote controller entity for the heating system. The remote data processing unit 14 may be arranged to collect and store data concerning the devices under its control in its database 15. The data may  
10 include identification information of the devices, operation parameters for the devices, information of the users and/or entities that are allowed to control the operation of devices by the data processing unit 14 and so on. The data processing unit 14 may accomplish various control functions such as  
15 general management of a number of devices within a household or several households.

Figure 7 shows a flow chart for operation where control information is transmitted from the remote entity 14 to the  
20 domestic appliance 1. The initiative for the transmission may vary, but may be e.g. a control request by the homeowner. The control may be accomplished by sending control instructions to the device 1 to be controlled over the public land mobile network 31 and the local wireless service 32. The control  
25 instructions may include instructions to perform a given task, software updates, maintenance instructions, or any other instructions relating to the control and use of a device the at the household 16.

30 Possible communication media in accordance with the principles of the present invention was already discussed above.

In addition to transmission of control information from the controller 14 to the device 1, the remote controller unit 14 may also receive information from the device 1. The arrangement may be such that the wireless module 11 of the device 1 is adapted to monitor continuously if a mobile station with a co-operational wireless module has entered the short range radio link service area thereof. Upon detection of such a mobile station 20, the device 1 may send an initial request for data transmission. The mobile station 20 receives the request. If the mobile station 20 is capable of transmitting the data further towards the mobile network 31, it will transmit a response to the device 1 acknowledging this. Data will thereafter be transmitted between the device 1 and the mobile station 20 via the established short range radio link.

Referring now also to Figure 8, a remote controller 14 may comprise a data processing unit such as a server. In addition to required memory and data processing means, the remote controller apparatus may comprise a display 56 for displaying various information, a keypad 57 for enabling input of information and various other additional devices such as a printer.

The remote unit 14 may be arranged to initiate transmission of control instructions, e.g. based on a periodic scheme of sending control instruction updates. The transmission may also be initiated by a person who is entitled to use the unit 14 for control purposes. The initiation may also be triggered by control instructions received from a user terminal. That is, it is possible to manage the operation of the remote unit 14 e.g. by means of a mobile station 53 or 54 or other terminal connected to the telecommunication system 31. For example, any



person who is entitled to issue control instructions concerning any of the domestic appliances 1 to 3 of the household 16, may use his mobile station 53 or 54 for transmitting instructions to the controller 14 via the PLMN

5 31. A data processing device, such as a personal computer (PC), connected directly to the data network 28 may also be used for managing the controller 14. The identity of the instructor may be verified at the controller 14 e.g. based on a password, an IMSI (International Mobile Subscriber Identity)  
10 code or a MSISDN (Mobile Station International ISDN Number) or any other suitable verification arrangement.

According to an embodiment information is transmitted in one or several hops between the domestic appliances. This may be  
15 preferred e.g. in instances where those devices that are in the back of a house would be too far away from the area where most of the mobile users are. One of the devices, e.g. the device 10 in Figure 6, may act as a central transceiver (as a hub) whereas the wireless modules 11' and 11'' of the other  
20 devices 1 and 2, respectively, communicate towards it. The wireless module 11 of the device 10 may be more powerful than the wireless modules of the other devices.

In accordance with a still further embodiment the hub  
25 comprises a controller for a utility system, such as a meter for consumption of electricity, water or gas. The use of a utility system controller as a hub may be advantageous, for example since each household is typically provided with at least one such a device. The controller units are typically  
30 well standardised. The modern controller units are also typically provided with data processing facility. Therefore it may be easier to provide each household with a standardised interface for the remote control. In addition, the utility

meter may be always powered, i.e. always on. If an electric meter is used as a hub, it is always connected to an electric power supply system. Whether the utility meters form a hub or not, they may be read remotely by means of the embodiments system and the subsequent control or management operations, such as utility system resource control or billing, may be based on the remote reading of the meters.

It shall be appreciated that the radio interface between the mobile station and the domestic device may be provided by any appropriate local communication media. Examples of these include local links that employ protocols defined by the IEEE (such as IEEE 802.11b and IEEE 802.11a) or IrDA (Infrared Data Association). Local HomeRF type interfaces may also be used.

It shall be appreciated that whilst embodiments of the present invention have been described in relation to mobile stations, embodiments of the present invention are applicable to any other suitable type of user equipment that may be provided with a wireless device that is co-operative with the wireless module associated with the on-site controller. In addition, the connection between the data processing device 14 and the PLMN 31 does not necessarily need to be accomplished via the Internet 28. It is possible, for example, to replace the Gateway 26 by a dedicated data collector/concentrator which provides local processing specifically for metering data and forwards data to the utility system via dedicated links or via the Internet. The Gateway may be replaced with a general purpose mailbox type capability, i.e. a facility that corresponds to a store/forward capability when a telephone is switched off or out of range. This may remove the interactive element of the communication and may have some limitations, but is likely to provide adequate level of communication for

enabling the embodiments. The Mobile Switching Centre 24 may route conventional phone calls via the standard PSTN or PLMN networks to the remote data collector that may be sited at the utility company's premises.

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If improved security is desired, it is possible to encrypt the information prior transmission or at an appropriate stage of transmission.

- 10 The embodiments facilitate a system in which neither the short range radio link, the mobile station, the telephone company, or the Internet provider may need to obtain any application specific processing facility or functionality. This enables a cost effective solution for the communication between the
- 15 remote data processing unit and the on-site controller of the utility commodity system. The universal short range or general purpose local wireless service modules are cheap and can be easily adapted to the meters or other on-site controllers of a utility commodity system. In addition, the running cost
- 20 thereof is minimal, as the radio links between the modules and the mobile stations provided with co-operative devices may be free of charge and the consumer may not be responsible for the capital costs of the mobile station. Therefore the problems related to the prior art systems using dedicated radio devices
- 25 can be avoided. Instead, any mobile station can be used as an intermediate gateway between the control unit and the telecommunication network. The embodiments may enable a continuous collection of substantially real-time information, especially in areas where the mobile station penetration is
- 30 substantially high. The universal local wireless modules may also enable use thereof in connection with any telecommunications standard and any utility commodity supply system standard. If only consumption snapshot type information

is desired, the supplier may not need to have information from all of its customers. Instead, a representative sample may be enough. Given the very large numbers of meters, collecting instantaneous information on consumption from even 0.1% of the  
5 customers would typically provide over 1000 values and be adequate to allow a statistical extrapolation.

It is noted herein that while the above describes exemplifying embodiments of the invention, there are several variations and  
10 modifications which may be made to the disclosed solution without departing from the scope of the present invention as defined in the appended claims.

## Claims

1. A method for communication between an on-site controller of a utility commodity system and a remote data processing unit associated with the utility commodity system, wherein the on-site controller is associated with a wireless module, the remote unit is provided with a connection to a telecommunications system that provides wireless communication for a plurality of mobile stations, and each mobile station of the plurality of mobile stations is enabled to communicate with the wireless module, the method comprising:

detecting that a mobile station of said plurality of mobile stations is located such that it is possible to establish a wireless link in accordance with a first wireless mode between the wireless module and said mobile station; and upon detection of the possibility for the wireless link, transmitting information between the controller and the remote unit via a first wireless link that is established in accordance with the first wireless mode between the wireless module and the mobile station and a second wireless link between the mobile station and the wireless telecommunication system, said second wireless link being based on a second wireless mode, wherein the mobile station acts as a gateway between the first and second wireless links.

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2. A method as claimed in claim 1, wherein the first wireless link comprises a short range radio link between the mobile station and the wireless module.

30 3. A method as claimed in claim 1 or 2, wherein the first wireless link is based on use of at least one unlicensed radio frequency band.

4. A method as claimed in any preceding claim, wherein the first wireless link is based on a universal low power radio frequency service protocol.

5 5. A method as claimed in any preceding claim, wherein the first wireless link operates at a frequency band range that is about 2.4 GHz.

6. A method as claimed in any preceding claim, wherein the  
10 first wireless link employs frequency hopping.

7. A method as claimed in any preceding claim, wherein at least one of the transmissions comprises transmission of packet data.

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8. A method as claimed in claim 6 and 7, wherein the frequency of the transmission via the first wireless link is changed between the subsequent data packets.

20 9. A method as claimed in any preceding claim, wherein the first wireless link is based on a short range radio link protocol that is defined by Bluetooth Special Interest Group (SIG).

25 10. A method as claimed in any preceding claim, wherein each mobile station of said plurality of mobile stations is provided with a wireless module that is co-operative with the wireless module associated with the on-site controller.

30 11. A method as claimed in any preceding claim, wherein the transmission of information between the controller and the remote unit is transparent to the user of the mobile station.

12. A method as claimed in any preceding claim, wherein information is transmitted from the on-site controller to the remote data processing unit.

5 13. A method as claimed in claim 12, wherein the information comprises one or more of the following: raw utility consumption information; processed utility consumption information; environmental information; status information; diagnostic usage information; a notification; a request for  
10 maintenance.

14. A method as claimed in any preceding claim, wherein information is transmitted from the remote data processing unit to the on-site controller.

15 15. A method as claimed in claim 14, wherein the information comprises control instructions for the on-site controller or a device that associates with the on-site controller.

20 16. A method as claimed in claim 14 or 15, wherein the information comprises one of more of the following: control instructions to switch between different modes of operation, an update of control instructions and/or software of the controller or a device that associates with the controller;  
25 maintenance instructions; information that relates to charging; announcements to be displayed on-site for the consumer of the utility.

30 17. A method as claimed in any preceding claim, wherein the transmission of information to and/or from the controller is accomplished in parallel with another transmission between the mobile station and the wireless telecommunication system.

18. A method as claimed in any preceding claim, wherein the telecommunication system comprises at least one cellular telecommunication network.
- 5 19. A method as claimed in any preceding claim, wherein the transmission of information between the on-site controller and the remote unit comprises transmission of information based on the wireless application protocol (WAP).
- 10 20. A method as claimed in claim 20, wherein the wireless application protocol provides the mobile station with an access to a data network.
- 15 21. A method as claimed in any preceding claim, wherein the transmission of information between the on-site controller and the remote unit comprises transmission of at least one message by means of a short message service offered by the telecommunication system.
- 20 22. A method as claimed in any preceding claim, wherein the transmission of information between the on-site controller and the remote unit comprises transmission of at least one text message.
- 25 23. A method as claimed in any preceding claim, wherein the information transmitted between the remote unit and the on-site controller includes information on the identity of the on-site controller.
- 30 24. A method as claimed in any preceding claim, wherein more than one mobile station is used for the transmission of information between the controller and the remote unit.



25. A method as claimed in any preceding claim, wherein at least two different communication protocols are employed in the transmission of information between the controller and the remote unit.

5

26. A method as claimed in any preceding claim, wherein a wireless link is offered by the mobile station to all wireless modules within the range of the local wireless service area of the mobile station.

10

27. A method as claimed in any preceding claim, wherein the wireless module that associates with the controller detects that a wireless link has become available.

15

28. A method as claimed in any preceding claim, wherein a wireless link is offered by the wireless module of the controller to all mobile stations that are located within the local wireless service area of said wireless module.

20

29. A method as claimed in any preceding claim, wherein the mobile station detects that a wireless link towards the wireless module that associates with the on-site controller has become available.

25

30. A method as claimed in any preceding claim, wherein the on-site controller initiates a setup procedure for the first wireless link.

30

31. A method as claimed in any preceding claim, wherein the controller stores information for transmission to the remote unit until the local wireless service is determined to be available.

32. A method as claimed in any preceding claim, wherein the mobile station stores information for transmission to the controller until the first wireless link is determined to be available.

5

33. A method as claimed in any preceding claim, wherein the telecommunications system stores information for transmission to the controller until the first wireless link is determined to be available

10

34. A method as claimed in any preceding claim, wherein the information is transmitted via a data network.

15

35. A method as claimed in claim 34, wherein the data network is based on the internet protocol.

20

36. A method as claimed in any preceding claim, wherein the operator of the utility commodity system is charged for at least one of the wireless links between the controller and the remote unit.

25

37. A method as claimed in any preceding claim, wherein the utility commodity comprises one of electricity, water, gas, district heat, or sewage.

25

38. A method as claimed in any preceding claim, wherein the on-site controller is located in a household.

30

39. A method as claimed in any preceding claim, wherein the on-site controller comprises a meter for metering the consumption of the utility commodity.

40. A method as claimed in claim 39, wherein the information comprises the reading of the meter.

41. A method as claimed in any preceding claim, wherein the  
5 telecommunication system provides information concerning the location of at least one mobile station.

42. A method as claimed in any preceding claim, wherein the  
controller communicates with at least one appliance that is  
10 located at the same site with the on-site controller.

43. A method as claimed in claim 42, wherein the  
communication between the controller and said at least one  
appliance is based on the first communication protocol.

15

44. A method as claimed in claim 42 or 43, wherein said at  
least one appliance presents a message based on control  
information received from the controller.

45. A method as claimed in any preceding claim, wherein the  
mobile station may be selectively switched between a mode  
where it is detectable by the wireless module that associates  
with the on-site controller and a mode where said wireless  
controller may not detect the mobile station.

25

46. A method as claimed in any preceding claim, wherein  
information is transmitted between the mobile station and the  
remote unit only when the mobile station has a connection with  
the telecommunication system.

30

47. A method as claimed in any preceding claim, wherein the  
mobile station is selectively instructed to allow or to deny

transmission of information between the on-site controller and the remote unit.

48. A method as claimed in any preceding claim, wherein the  
5 mobile station is moved around by an agent.

49. A method as claimed in any preceding claim, wherein  
connection history of the on-site controller is stored in a  
database, and the initiation of a connection between the  
10 mobile station and the wireless module that associates with  
the on-site controller is based on the history data.

50. A method as claimed in any preceding claim, comprising  
dynamic identity allocation.

15  
51. A method as claimed in any preceding claim, comprising  
transmission of information between a first wireless local  
network and a second local wireless network, the wireless  
module that associates with the on-site controller belonging  
20 to the second local network and the information to be  
transmitted originating from the first local network.

52. A method as claimed in claim 51, wherein the first local  
network comprises a meter for the utility and a domestic  
25 appliance, the first local network communicating with the  
second local network via said domestic appliance.

53. A method of transmitting control information between a  
device and a remote control entity, wherein said remote  
30 control entity is connected to a telecommunications system and  
said telecommunications system serves a plurality of mobile  
stations, the method comprising:

detecting that a mobile station of said plurality of mobile stations is located such that a wireless link in accordance with a first transmission mode can be established between communication means of the device and said mobile station;

setting up a first wireless link between the device and said mobile station;

transmitting control information between the device and said mobile station via the first wireless link and via a second wireless link that is established in accordance with a second transmission mode between said mobile station and the telecommunication system, wherein said mobile station provides a gateway function between the different wireless links.

54. A method as claimed in claim 53, wherein the control information comprises instructions for the device, the control information is received at the device, and the device is operated based on the received control instructions.

55. A method as claimed in claim 53, wherein the control instructions comprise at least one of: instructions to change the operational status of the device; an update of the operation instructions and/or rules of the controller; maintenance instructions.

56. A method as claimed in of claims 53 to 55, wherein the operation of remote control entity is managed by means of a user terminal, and wherein the remote entity generates control instructions for the device based on information received from the user terminal.

57. A method as claimed in any of claims 53 to 56, wherein the device comprises a control unit of utility commodity system.

5 58. A method as claimed in claim 57, wherein the control unit associates with a power supply system.

59. A method as claimed in any of claims 53 to 58, wherein a message is presented to a user of a domestic appliance based  
10 on said control information from the remote control entity.

60. An arrangement for a utility commodity system, the arrangement comprising:

an on-site control unit for controlling at least one  
15 function of the utility commodity system at a location of consumption of the utility commodity;

a wireless module associated with the on-site control unit, the wireless module being arranged to operate in accordance with a first wireless mode;

20 a telecommunications system arranged to provide wireless communication for a plurality of mobile stations in accordance with a second wireless mode;

a remote processing unit for managing at least one function of the utility commodity supply system, said remote  
25 processing unit being connected to the telecommunications system;

a plurality of mobile stations subscribing to the telecommunications system, each of the mobile stations being arranged to transmit and receive signals in accordance with  
30 the first and the second wireless modes and to provide a gateway between said two transmission modes;

detector means for detecting that a mobile station of the plurality of mobile stations is located such that it is

possible to have a wireless link between said mobile station and the wireless module, the arrangement being such that upon detection of the possibility for the wireless link information may be transmitted between the on-site control unit and the remote unit via a wireless link between the wireless module and the mobile station in accordance with the first wireless mode and a further wireless link in accordance with the second wireless mode.

61. An arrangement as claimed in claim 60, wherein the first wireless link comprises a short range radio link between the mobile station and the wireless module, the link being based on a universal low power radio frequency service protocol.

62. An arrangement as claimed in claim 60 or 61, wherein the first wireless link is adapted to employ frequency hopping.

63. An arrangement as claimed in any of claims 60 to 62, wherein the first wireless link is based on a short range radio link protocol that is defined by Bluetooth Special Interest Group (SIG).

64. An arrangement as claimed in any of claims 60 to 63, wherein the on-site controller comprises a meter for metering consumption of the utility commodity.

65. An arrangement as claimed in claim 64, wherein the information comprises the reading of the meter.

66. An on-site controller for controlling at least one function of a utility commodity system, comprising a transceiver module for enabling wireless transmission from and to the on-site controller in accordance with a short range

radio link protocol, the module being adapted to detect that a mobile station of a plurality of mobile stations is located such that a short range radio link may be established between the mobile station and the wireless module, wherein the arrangement is such that upon said detection a short range radio link may be established and information may be transmitted between the on-site controller and the mobile station.

- 10 67. An on-site controller as claimed in claim 66, wherein the on-site controller comprises a meter for metering the consumption of the utility commodity and the information comprises the reading of the meter.



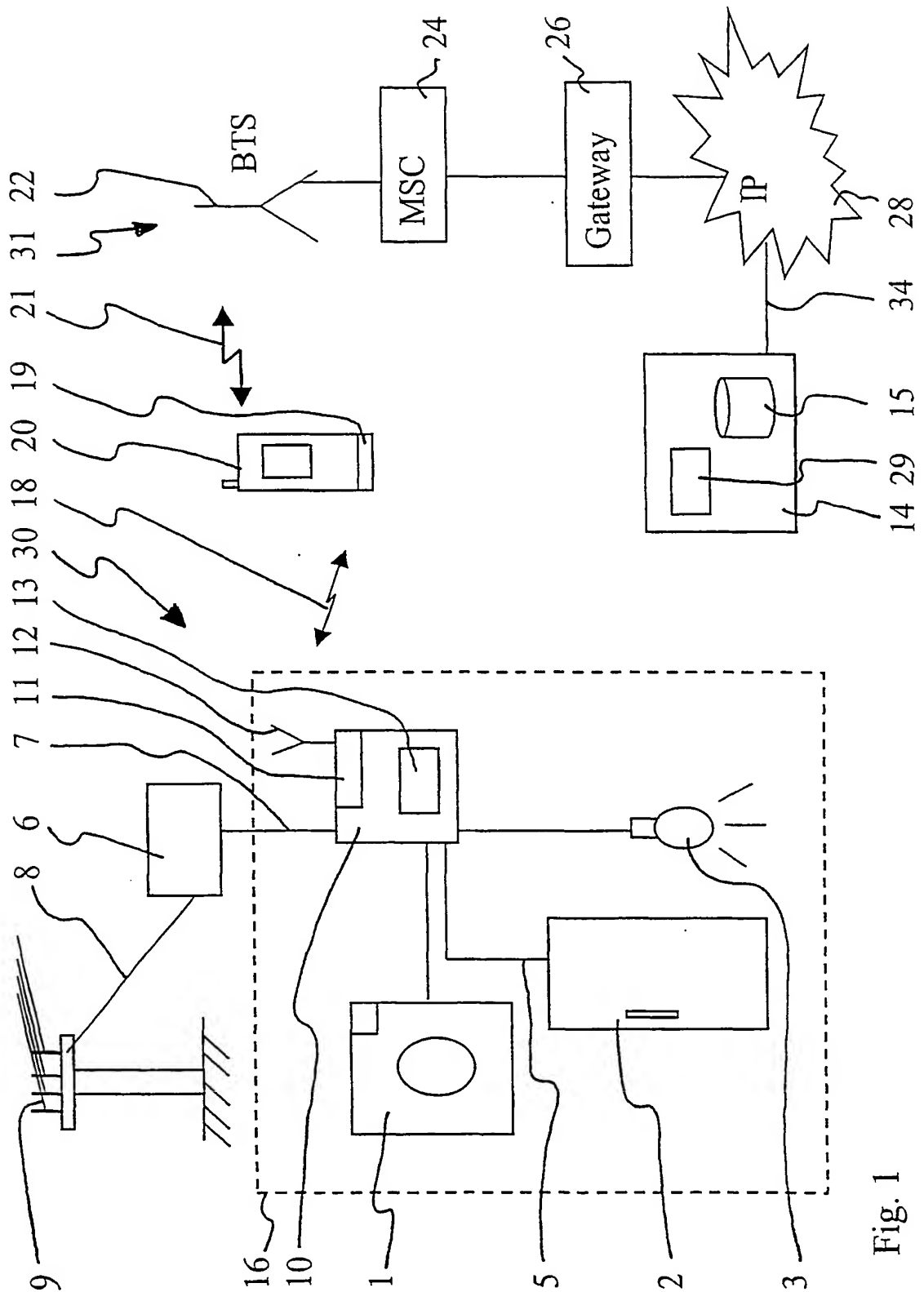


Fig. 1

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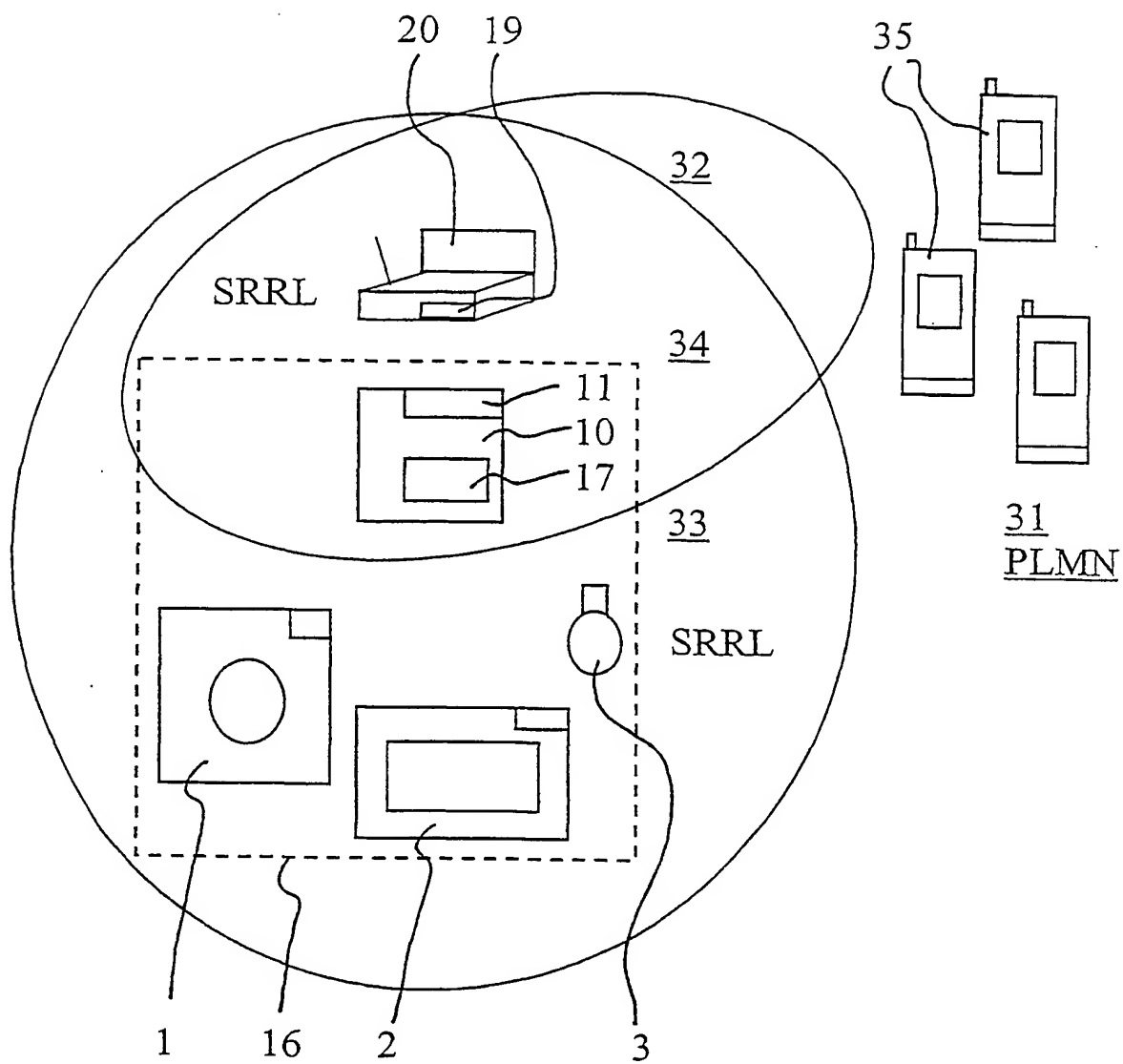


Fig. 2

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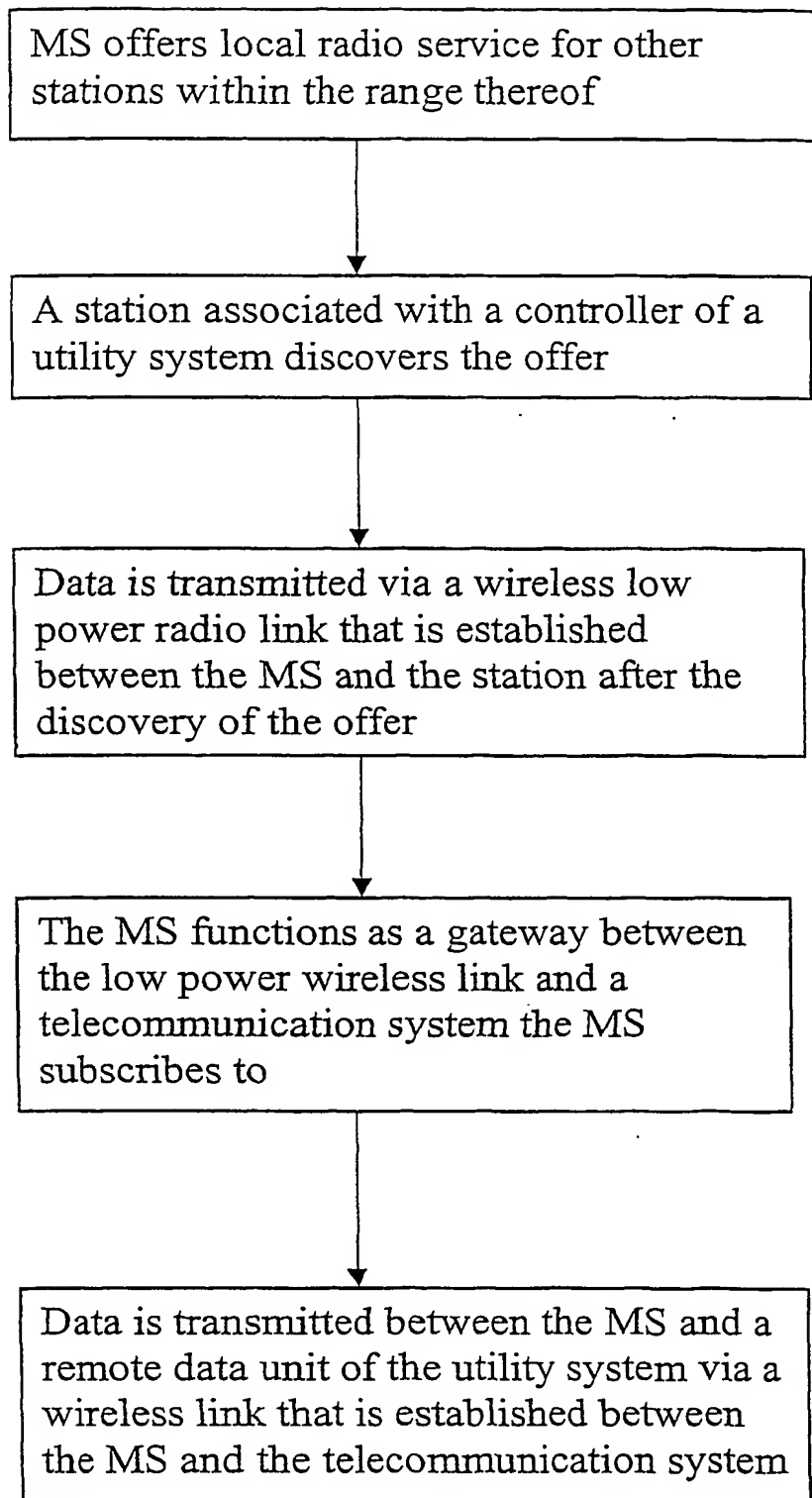


Fig. 3

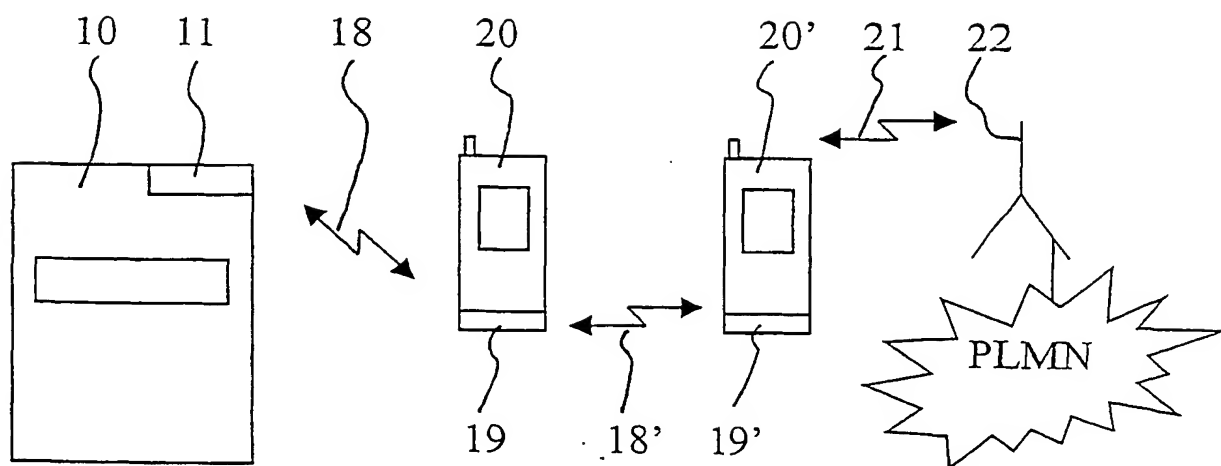


Fig. 4

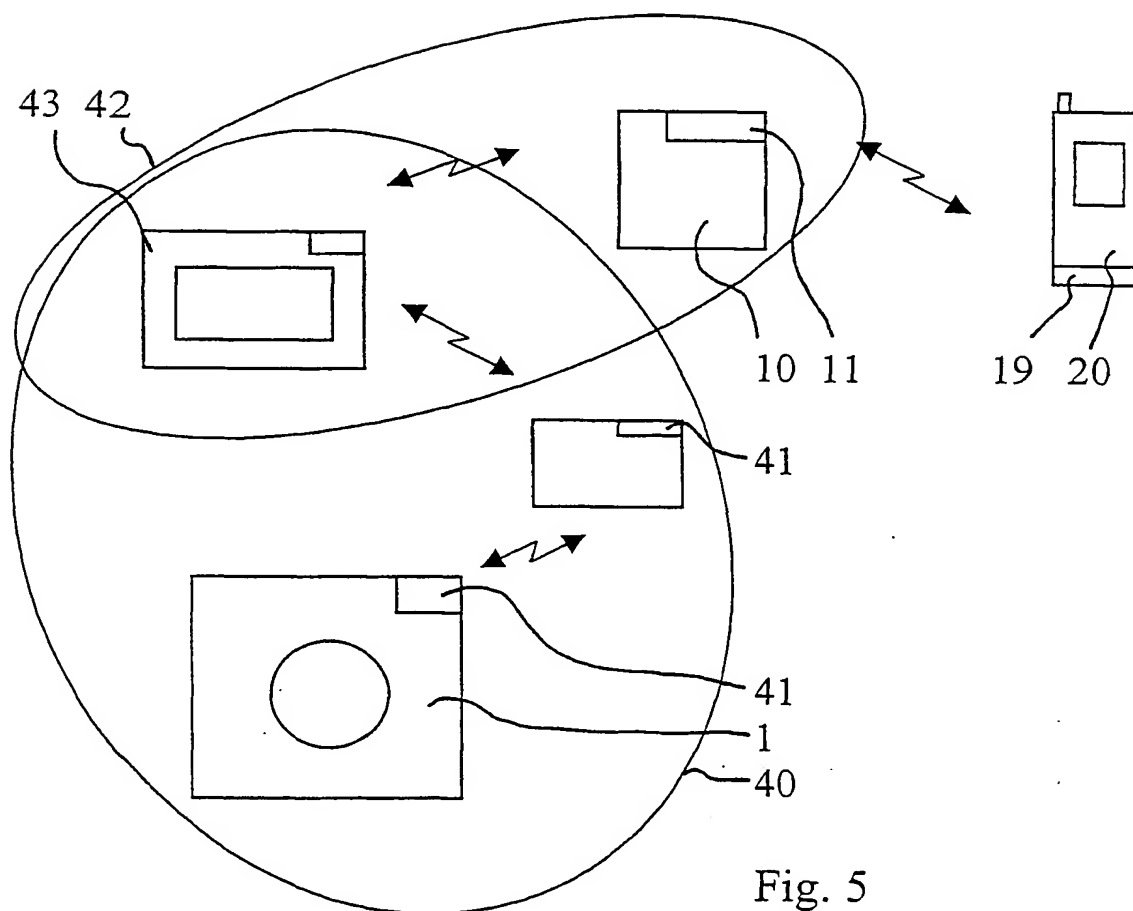


Fig. 5

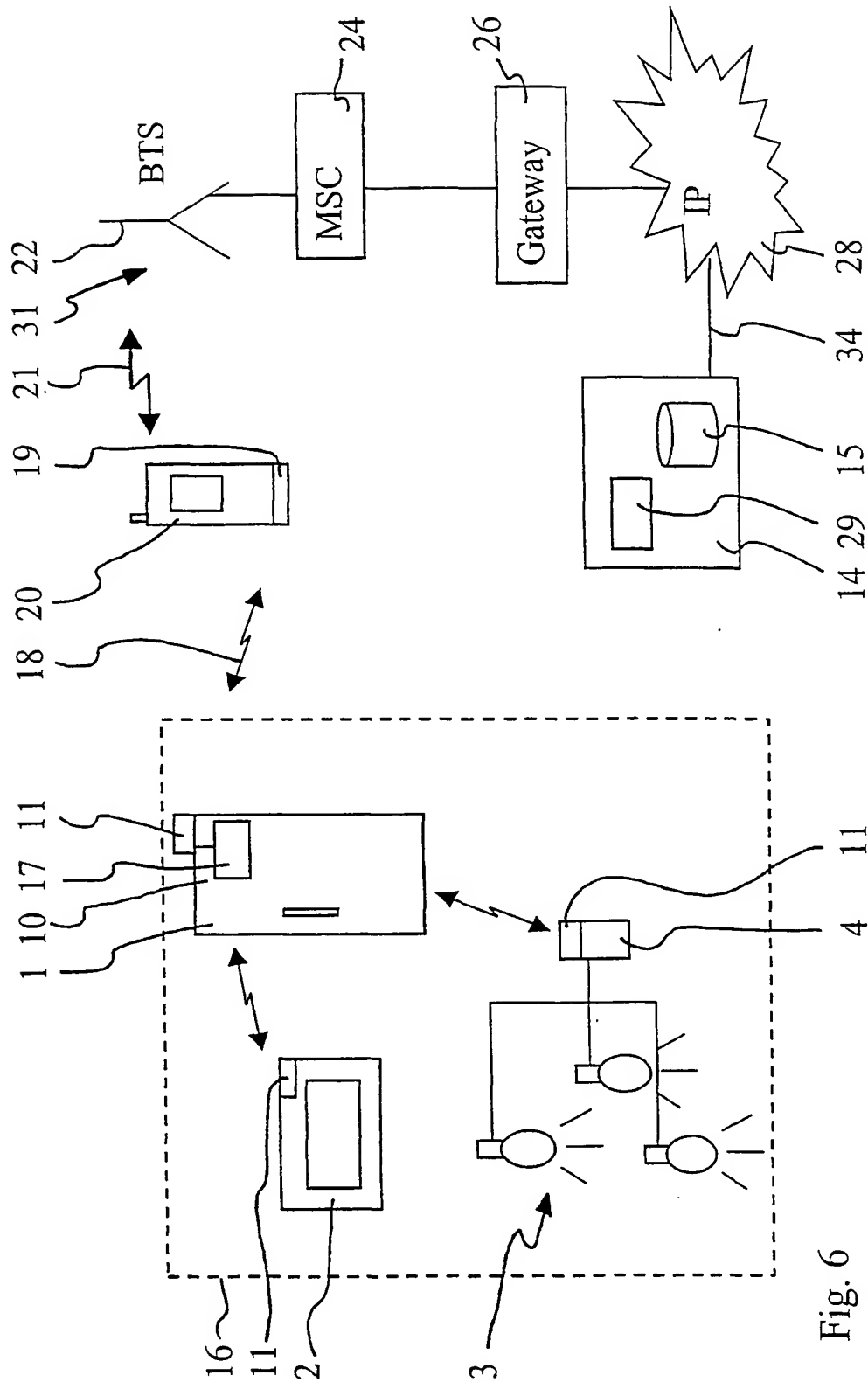


Fig. 6

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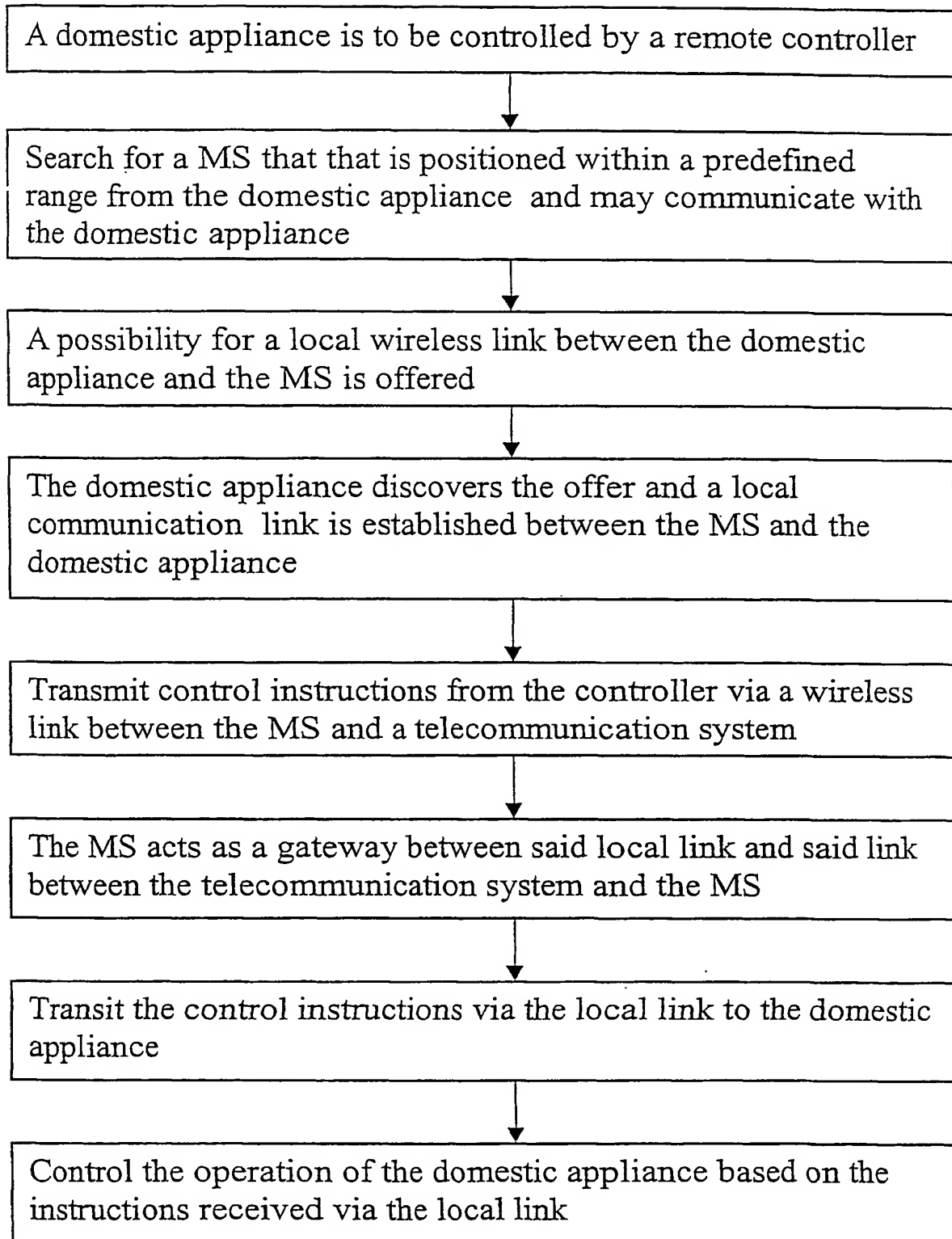


Fig. 7

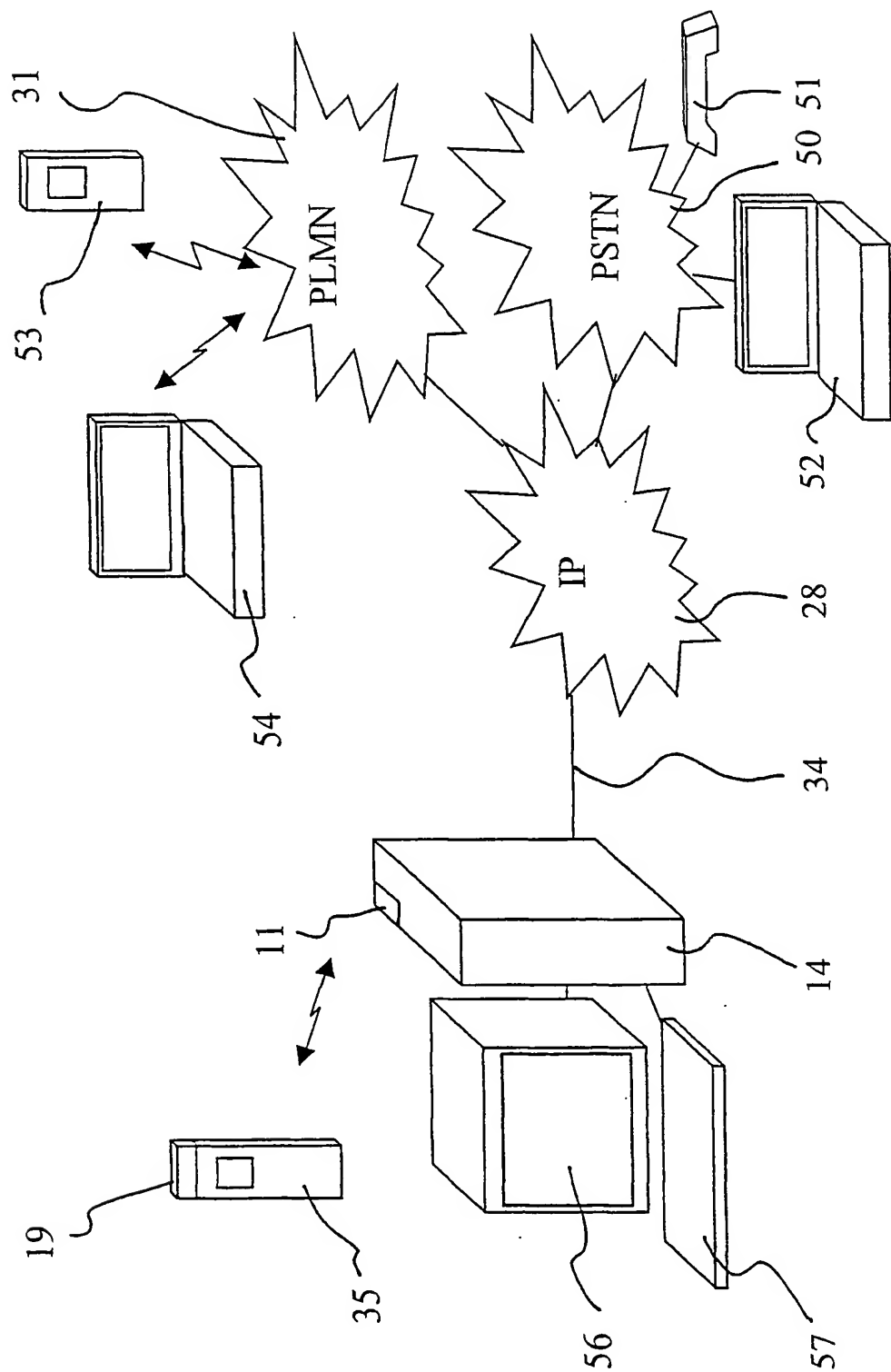


Fig. 8

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 01/01312

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04M11/00 H04L12/56

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04M H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99 46921 A (NOKIA MOBILE PHONES LTD ;OKKONEN HARRI (FI); HEINONEN PEKKA (FI)) 16 September 1999 (1999-09-16) abstract page 3, line 30 -page 4, line 24 page 5, line 19 -page 6, line 4 page 6, line 24 -page 7, line 15 page 9, line 6 - line 11 page 11, line 29 -page 12, line 11 page 12, line 24 - line 26 page 15, line 17 - line 27 figures 1-4  ---  -/-	1-67



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Date of the actual completion of the international search

28 August 2001

Date of mailing of the international search report

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>WO 98 27764 A (AT &amp; T WIRELESS SERVICES INC) 25 June 1998 (1998-06-25) abstract page 3, line 5 - line 22 page 7, line 14 -page 9, line 2 claims 1,5 figures 1,2</p> <p>-----</p>	1-67

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 01/01312

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9946921 A	16-09-1999	FI 980538 A AU 2426999 A EP 1062799 A	10-09-1999 27-09-1999 27-12-2000
WO 9827764 A	25-06-1998	US 6169895 B	02-01-2001

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